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SUMMARY OF WATER QUALTY CONTROL AND MANAGEMENT, WILLAMETTE RIVER BASIN

James M. Quigley

Federal Water Pollution Control Administration
Portland, Oregon

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WATER QUALITY CONTROL AND MANAGEMENT

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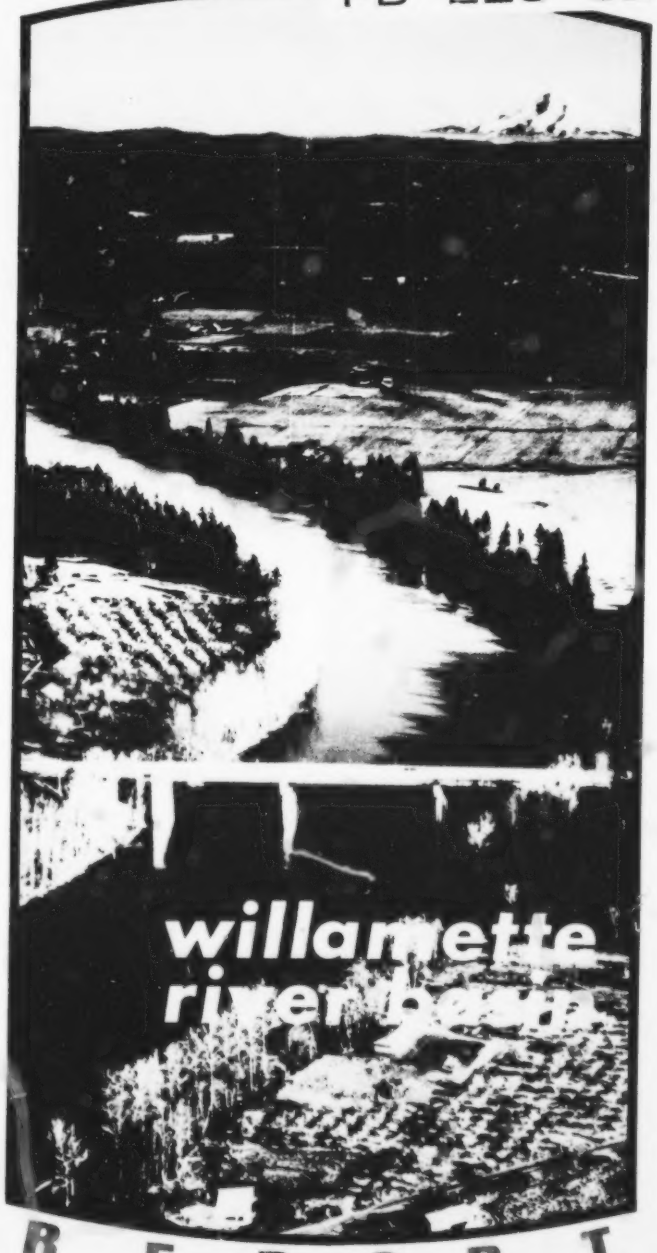
A COMPREHENSIVE POLLUTION CONTROL PROGRAM DEVELOPED BY THE FEDERAL WATER POLLUTION CONTROL ADMINISTRATION



SUMMARY OF:

WATER QUALTY CONTROL AND MANAGEMENT

DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
NORTHWEST REGION, PORTLAND, OREGON

JANUARY 1967

FOREWORD

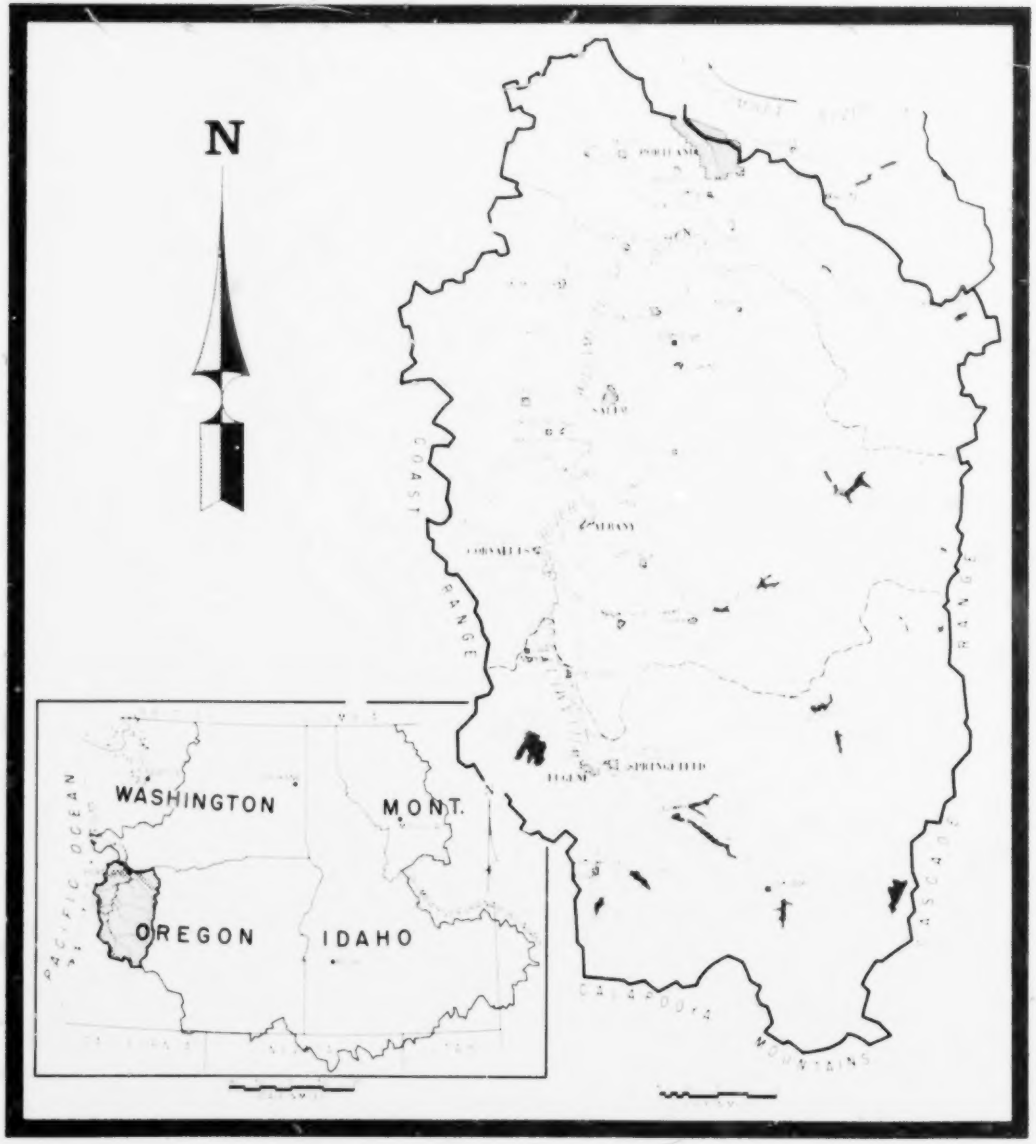
JAMES M. QUIGLEY, *Commissioner*
Federal Water Pollution Control Administration
U.S. Department of the Interior

Each summer the Willamette River becomes polluted. This splendid river, whose watershed supports two-thirds of Oregon's population and provides an equal proportion of its industrial output, suffers recurrently from massive outpourings of untreated industrial wastes. The effects of this pollution have been severe. The Willamette has largely been rejected as a source of water supply, and communities along its banks have had to develop other, and more costly, sources. Recreation has been curtailed, with many parks posted against swimming and the whole river below the city of Eugene exceeding Pacific Northwest Pollution Control Council bacterial objectives for water-contact recreation. Fish production has declined, as the natural habitat for trout has shrunk, and as passage conditions and spawning areas for that large portion of the Pacific salmon run that is based upon the Willamette have deteriorated with the persistence of pollution.

These conditions have existed for more than three decades. Gradual progress has been made in pollution abatement as a result of institution of waste treatment and summer flow augmentation from Federal storage reservoirs; but at the same time the magnitude of pollution sources has advanced. Industrial expansion, population growth, and urbanization have all acted to increase wastes and to offset much of the progress that has occurred.

In 1961 the Water Supply and Pollution Control Division of the Public Health Service began a comprehensive study of water quality in the Columbia River Basin. The study, continued under the Federal Water Pollution Control Administration, has included considerable emphasis on the Willamette Basin, since it contains the clearest and most significant instances of water pollution found in the Columbia Basin. This is a summary of the Willamette River Basin report which contains a detailed analysis of the nature and extent of pollution, its cause, what may be done to abate it and prevent its recurrence, and what it will cost to control it.

The course of action recommended in that report is based upon the decision of the people of Oregon—a decision manifested by the repeated pronouncements of its public officials and by legislative enactments going back to the Act of 1938 creating a state agency with responsibility for control of water pollution—that the waters of the Willamette system are to be fit habitats for salmonid fish, suitable sources of recreation, and usable water supplies. These are demanding goals, in terms of water quality, but no lesser goals have ever been publicly advanced. Unfortunately the public and private actions needed to fulfill these goals have not always been forthcoming. This report sets forth a plan for such actions. Whether this plan will achieve its purpose is also a decision which rests largely with the people of Oregon.



The Federal Water Pollution Control Act (33 U. S. C. 466 *et seq.*) contains among its provisions a direction to the Secretary of the Interior to develop comprehensive programs for controlling pollution of interstate waters and their tributaries. This document is an interpretive summary of a report presenting such a program for Oregon's Willamette River.

The major report, *Water Quality Control and Management. Willamette River Basin*, presents the results of a painstaking study of the water quality of the Willamette River system, the uses of the river system, the factors that affect water quality, the probable nature of the economic development of the watershed and its impact on water quality, and the nature of measures that must be taken both to abate pollution in the river system and to prevent recurrence of pollution. While the report was prepared by the Federal Water Pollution Control Administration, which bore the major responsibility for developing the study, a number of Federal and Oregon State and local agencies provided important assistance in collecting and analyzing data. In particular, the Oregon State Sanitary Authority accepted a very large role in developing both information and concepts.

This summary report is focused on the presentation of the principal findings of the study as they relate to requirements for action to control pollution. It emphasizes that pollution does exist in the Willamette River system, that pulp and paper mills that have been subject to less stringent waste control requirements than municipalities and other sources of waste are the major causes of pollution, that pollution abatement will require immediate improvements in the level of waste reduction achieved in the Willamette River system, and that the continuing control of pollution will impose demands for action well into the future upon the people and industries of the Willamette River Basin, as well as upon the State and Federal agencies that serve them.

IMMEDIATE POLLUTION ABATEMENT

1.

2.

3.

LONG TERM POLLUTION CONTROL

1. The State of Oregon should encourage and provide assistance in development of institutional arrangements that bring appropriate communities, industries, and metropolitan areas together for the purpose of planning and financing pollution control measures within the framework provided by drainage areas

2. Reallocation of functions of the Federal reservoir system in the Willamette River Basin, to be considered in 1970 upon completion of a joint State of Oregon-Federal agencies study of water and related land resources of the basin, should recognize the overlapping benefits to water quality, fishery, and recreation that are obtainable with maintenance of summer base flows of at least 7 500 cubic feet per second through Portland harbor, 260 cubic feet per second in the lower Tualatin River, and 100 cubic feet per second in the South Santiam River below Lebanon

3. The State of Oregon should establish limits for waste loads in intensively used watersheds Such limits should reflect characteristics of wastes, minimum streamflow probabilities and quality of waste control techniques available within the watershed.

4. Data gathering and monitoring activities of the Oregon State Sanitary Authority and of the Federal Water Pollution Control Administration should be coordinated and expanded to maintain intimate knowledge of waste loadings treatment plant efficiencies streamflows, and reservoir operations, in order that such information may be utilized in mathematical simulations of the river system as planning tools and instruments of day to day water quality management

5. Programs of Federal resource management agencies operating in the Willamette River Basin should be periodically reviewed by the Federal Water Pollution Control Administration for possible impacts on water quality, with the Federal Water Pollution Control Administration and the several agencies jointly developing and monitoring effects of procedures to avoid adverse impacts, and coordinating such programs with Oregon State and local watershed organizations' pollution control plans.

I. POLLUTION PROBLEMS

the major portion of strong pulping wastes. Treatment is, however, inadequate to sustain desired water quality.

Pollution of the Tualatin River is caused by the heavy degree of development that is imposed on the limited resources of the watershed. The normal low summer streamflows are further reduced by irrigation withdrawals, and the wastes of a number of communities and industries are discharged into the river. The Tualatin Basin supports a principal suburban area of the city of Portland, and the density of population results in a level of waste production that periodically exceeds the assimilative capabilities of the stream, even after treatment removes more than 90 percent of oxygen-consuming wastes. Urban and agricultural runoff contribute additional nutrients and organic wastes, adding to intense algal activity which compounds the problem.

II. POLLUTION DAMAGES

Extremely high water quality is required by uses that are made of the waters of the Willamette River system. Municipal and industrial water supply, production of salmonid fish (salmon and trout), and recreation constitute prime uses of the Willamette's waters; and each can be curtailed, made more costly, or eliminated entirely by the existence of pollution. All of these uses are presently restricted in some measure by pollution. Bacterial contamination limits the sources for domestic, municipal, and food processing water supplies. Numbers of available recreation areas have been constricted by the presence of excessive bacterial concentrations. Interference with sport fishing has resulted from pollution-caused limitation of fish environments, and by the nuisance to both fishing and boating imposed by *Sphaerotilus*. Fish production is impeded by dissolved oxygen deficiencies and by sometimes high temperatures.

It is the damage to the fishery that is most costly. Water supplies can be treated prior to use, and alternative recreational sources are available—though both substitutions involve increases in user costs. There is no alternative source of salmon and trout. Where production of either is curtailed, it represents a diminution of an intensively used total supply. Since all migratory salmon utilizing the Willamette system must pass through the polluted lower reaches of the Willamette twice during their life cycle, the condition of Portland harbor represents a critical limitation on the productive capacity of the entire river system.

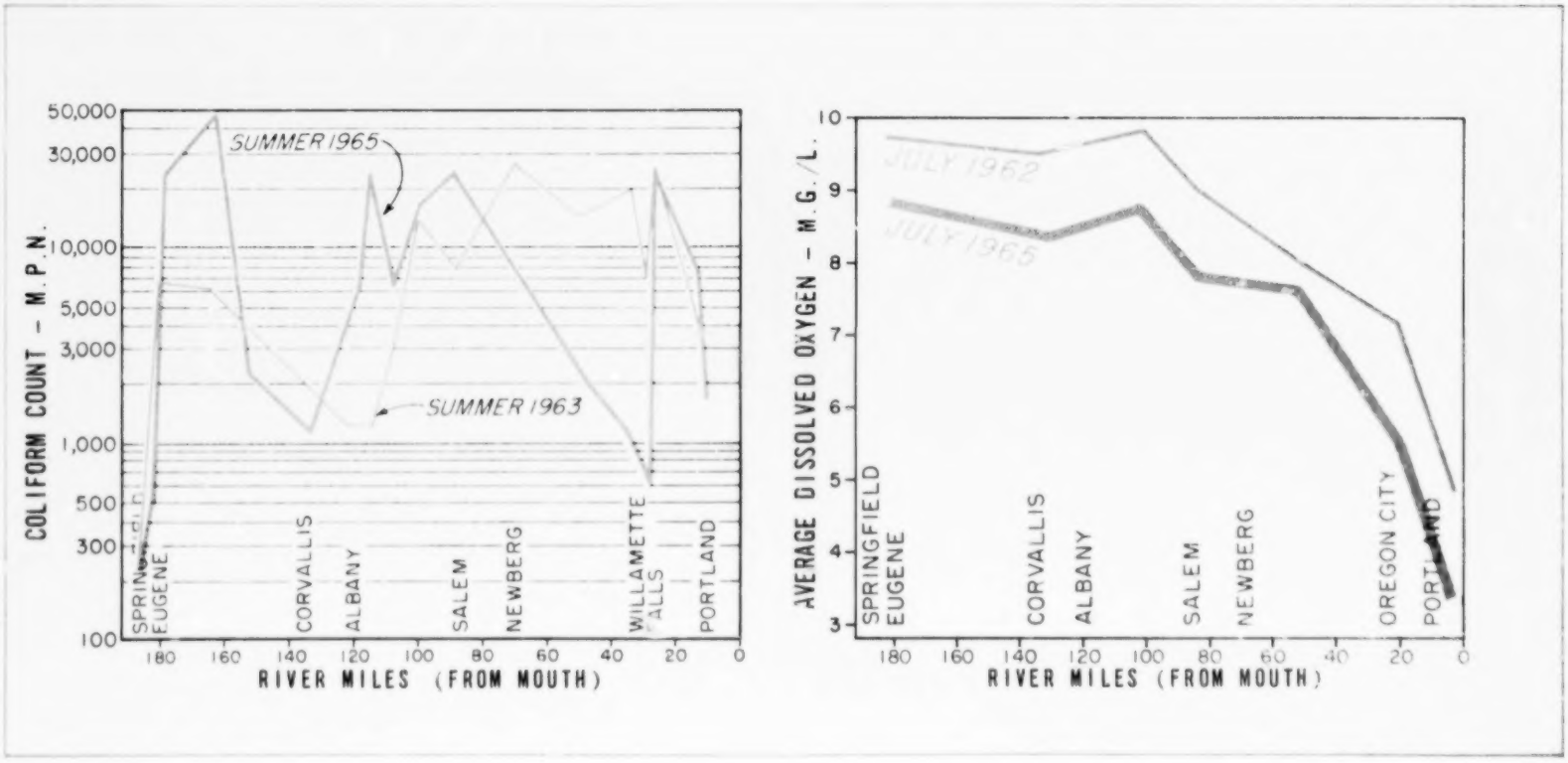
Dissolved oxygen requirements for passage of salmon are not nearly so high as for spawning, which requires near saturation of dissolved oxygen, or rearing which requires a concentration of seven milligrams per liter. Salmon passage may be readily accomplished with a dissolved oxygen concentration of five milligrams per liter. Unfortunately, summer dissolved oxygen concentrations in Portland harbor often fall below three milligrams per liter. While no upstream migration of salmon presently occurs during the summer, untimely low flows and consequent oxygen deficiency sometimes result in an "oxygen block" that prevents the latter stages of the spring migration upstream, or delays the start of the fall migration. In either situation, the spawning population is reduced by predation and other causes, with an adverse effect on production. Effect of the summer dissolved oxygen deficiency is more serious in the case of downstream migration of juvenile fish. The downstream migration goes on throughout the year, and a high mortality is believed to

occur among downstream migrants as a result of pollution in the Portland harbor.

III. DIFFICULTIES OF ABATEMENT

While the State of Oregon has recognized the fish production, water supply, and recreational uses of the Willamette River system in its classification of streams, and has adopted a program of pollution abatement designed to protect those functions of the watershed, its program has not been adequate to restore necessary quality to the river. The Oregon pollution control program has been most effective in reducing bacterial concentrations by encouraging the communities of the basin to develop waste treatment. It has not dealt successfully with problems of summer oxygen depletion, sludges, and slime growths. Pollution remedies have met with limited success because of two weaknesses: lack of control of pulp mill waste discharges, and lack of dependable summer streamflow.

There are seven pulp mills in the Willamette system. Six discharge their wastes directly into the Willamette River, and one discharges wastes into the South Santiam River. With two exceptions, these mills use the sulfite pulping process and do not recover cooking chemicals by condensing and burning wastes, as do plants utilizing the more modern sulfate or kraft process.



Since something over half of the wood inputs in pulping are, by the nature of the process, discarded as waste, enormous quantities of organic waste materials are generated in the production of pulp. Of some 6.2 million population equivalents of oxygen-demanding wastes produced in the Willamette River Basin, 70 percent—about 4.5 million population equivalents—occurs from pulp and paper production. And of the 4.9 million population equivalents of wastes that enter the Willamette River system after application of waste control measures, over 90 percent is from pulping and papermaking.

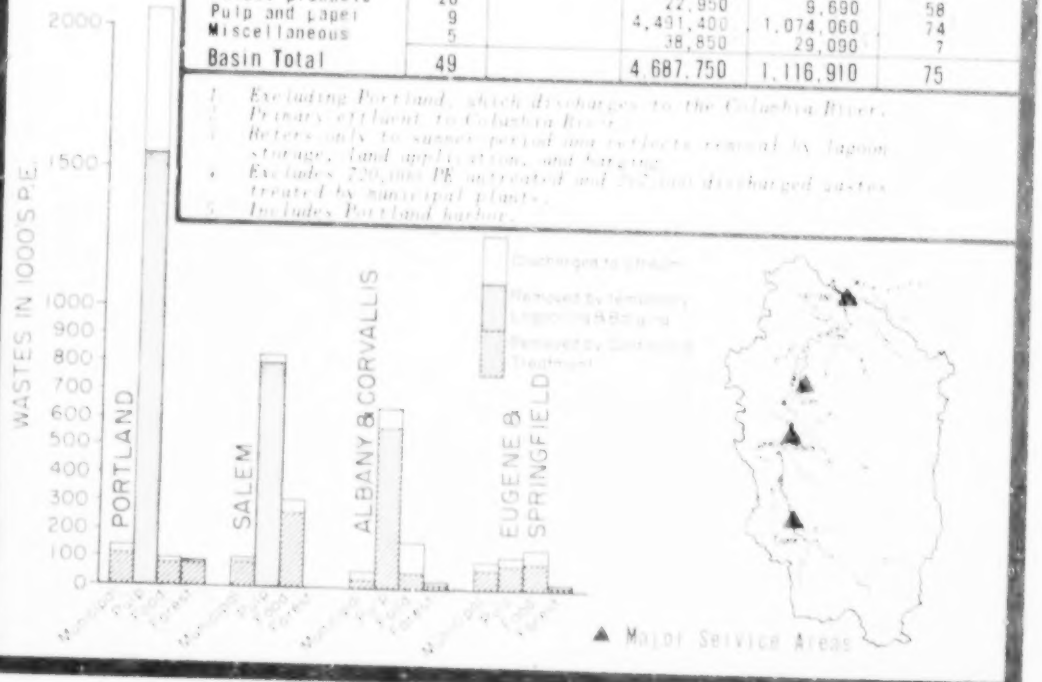
The State of Oregon has required a high level of waste treatment for municipalities of the basin; and, for the most part, they have responded to the State's demands. Of 91 communities in the Willamette River watershed, 74 provide secondary waste treatment or its equivalent, seven do not collect wastes, only one does not treat its wastes, and nine—including the largest city, Portland—have primary treatment. Food processing plants, as a group, provide a high level of waste reduction, in large part through use of joint municipal-industrial treatment facilities. Miscellaneous manufacturing plants do not match the waste treatment performance of municipalities or food processors, but neither do they constitute significant waste sources.

In distinction to other waste producers, the pulp and paper industry, the major source of wastes, has largely resisted the State of Oregon's efforts to enforce effective pollution abatement procedures. Only three of the seven mills achieve a reduction of their wastes discharges. The huge Weyer-

MUNICIPAL AND INDUSTRIAL WASTES
WILLAMETTE RIVER BASIN

	Number of Plants	Population Served	Population Equivalents Untreated	Population Equivalents Discharged	Removal Efficiency
PRESENT MUNICIPAL WASTE TREATMENT:					
Secondary	66	323,125	1,026,720	229,550	78
Primary[1]	8	36,350	140,950	96,880	32
Lagoon	8	5,390	5,410	940	83
Other	8	1,000	350	350	0
Subtotal	90	366,715	1,174,930	328,450	72
Portland (primary)	1	370,000	385,000		
Basin Total	91	736,715	1,559,930	328,450	79
PRESENT INDUSTRIAL WASTE TREATMENT:					
Food products	13		134,550	4,100[4]	97
Forest products	20		22,950	9,690	58
Pulp and paper	9		4,491,400	1,074,060	74
Miscellaneous	5		38,850	29,090[5]	7
Basin Total	49		4,687,750	1,116,910	75

1. Excluding Portland, which discharges to the Columbia River.
2. Primary effluent to Columbia River.
3. Refers only to summer period and reflects removal by lagoon storage, land application, and burning.
4. Excludes 220,000 PE untreated and 265,000 discharged wastes treated by municipal plants.
5. Includes Portland harbor.



haeuser Company plant at Springfield is one of the most efficient mills in the industry in terms of the ratio of discharged wastes to production: a kraft mill that condenses and burns its strong pulping wastes, the plant also provides primary and secondary treatment of residual wastes, recycles process waters to reduce wastes, and utilizes summer spray irrigation to dispose of a portion of its waste stream during periods of low streamflow. The Western Kraft Corporation plant at Albany, another kraft mill, also provides primary treatment and some beneficial recycling of process waters. The Crown Zellerbach Corporation plant at Lebanon, a sulfite mill, evaporates and dries or burns strong pulping liquors during the summer.

No treatment is presently provided by sulfite pulp mills at Salem, Newberg, Oregon City, and West Linn. Until recently, the State of Oregon was willing to accept storage or transport of a portion of the concentrated wastes of these plants during the low flow period as a substitute for treatment, a marked departure from its stringent policy toward other waste sources. The State initiated in 1965 the policy of requiring primary treatment by these mills, in order to reduce the organic solids that result in sludges and provide attachments and nutrients for *Sphaerotilus*. Primary treatment, however, effects little reduction in oxygen demand; and strong wastes will continue to be discharged to the river after primary treatment facilities have been installed.

The Willamette is a large river, and through most of the year it has a flow sufficient to absorb even the enormous waste discharges of pulp and paper production yet maintain acceptable dissolved oxygen levels. In summer, however, streamflow drops sharply, and with it the assimilative capacity of the river. A number of Federal reservoirs have been constructed in the upper basin since World War II. Releases from these, for purposes other than water quality control, have relieved the burden upon summer assimilative capacity by supplementing natural streamflow. Without such releases severe nuisance conditions, and often complete oxygen depletion, would occur in Portland harbor each summer. Oregon's pollution control program is based to a large degree upon the operation of these reservoirs. Allowable waste discharges for pulp mills and treatment requirements for municipalities have been predicated upon maintenance of a navigation flow of 5,500 cubic feet per second at Salem.

Unfortunately, flows for pollution control are not specifically provided in the authorization of these reservoirs. Pollution control benefits have occurred incidentally to reservoir releases for navigation. And in the operation of the reservoirs, power generating schedules, flood control needs, and reservoir recreation have sometimes conflicted with pollution control requirements. Water needed in summer for water quality control can, in a dry year, be held in reservoirs in order to provide for fall power-generation.

IV. POLLUTION ABATEMENT REQUIREMENTS

V. CONTINUING POLLUTION CONTROL

obsolete, will represent a continuing responsibility. Analysis of projected waste production and distribution indicates that for the most part secondary waste treatment will—with a slight increase in average treatment efficiency—adequately protect water quality. In the Tualatin River Basin, however, the magnitude of anticipated waste loads, even if recommended storage for quality control is provided, suggests that advanced waste treatment must be provided by municipalities and industries by the early 1970's. Similarly, pulp and paper mills, because they represent such significant waste sources, may be expected to provide something similar to conventional secondary waste treatment, in addition to primary treatment and reduction of concentrated pulping liquors.

Flow regulation for quality control is a needed supplement to waste treatment. Storage should be provided at a variety of sites, in order to meet the streamflow needs of tributaries as well as those of Portland harbor; and drafts on storage should be scheduled in a manner that makes most efficient use of water and of storage capacity.

In addition to needs that relate to physical facilities, effective, economic pollution control requires a number of institutional and procedural practices to effectuate continuing surveillance and control of water quality in the Willamette River system. The immediate need in this regard is the expansion and implementation of Oregon's stream standards for the Willamette River system in a manner that clearly defines water quality required to serve appropriate functions of the river, stream reach by stream reach. Such standards are required by Federal law for that portion of the river which is defined to be interstate water, by reason of its exposure to tidal influence. Standards for the major part of the river system which is wholly intrastate should obviously be compatible with the interstate standard.

Adjudication of water rights to permit establishment (by the Oregon Water Resources Board) of inviolable base flows in critical reaches of certain streams will be necessary if drafts on storage are to be a dependable controlling factor. Systematic monitoring and reporting of water quality, streamflow, and effluent characteristics must be provided, both to provide a continuing overview of water quality conditions and to permit use of predictive mathematical techniques that facilitate decision-making for water quality protection. Federal agency programs should be reviewed periodically by the Federal Water Pollution Control Administration for incorporation of procedures to safeguard water quality against possible adverse impacts. Reservoir scheduling should be available to provide streamflows, as needs are indicated by monitoring and surveillance of the river system, in order to make optimal use of water and storage capacity of the multi-purpose reservoir system. Measures to increase efficiency of waste treatment plant operation by providing incentives and training to plant operators, methods to control waste discharges of vessels and houseboats, to control erosion from land management practices, and to pre-

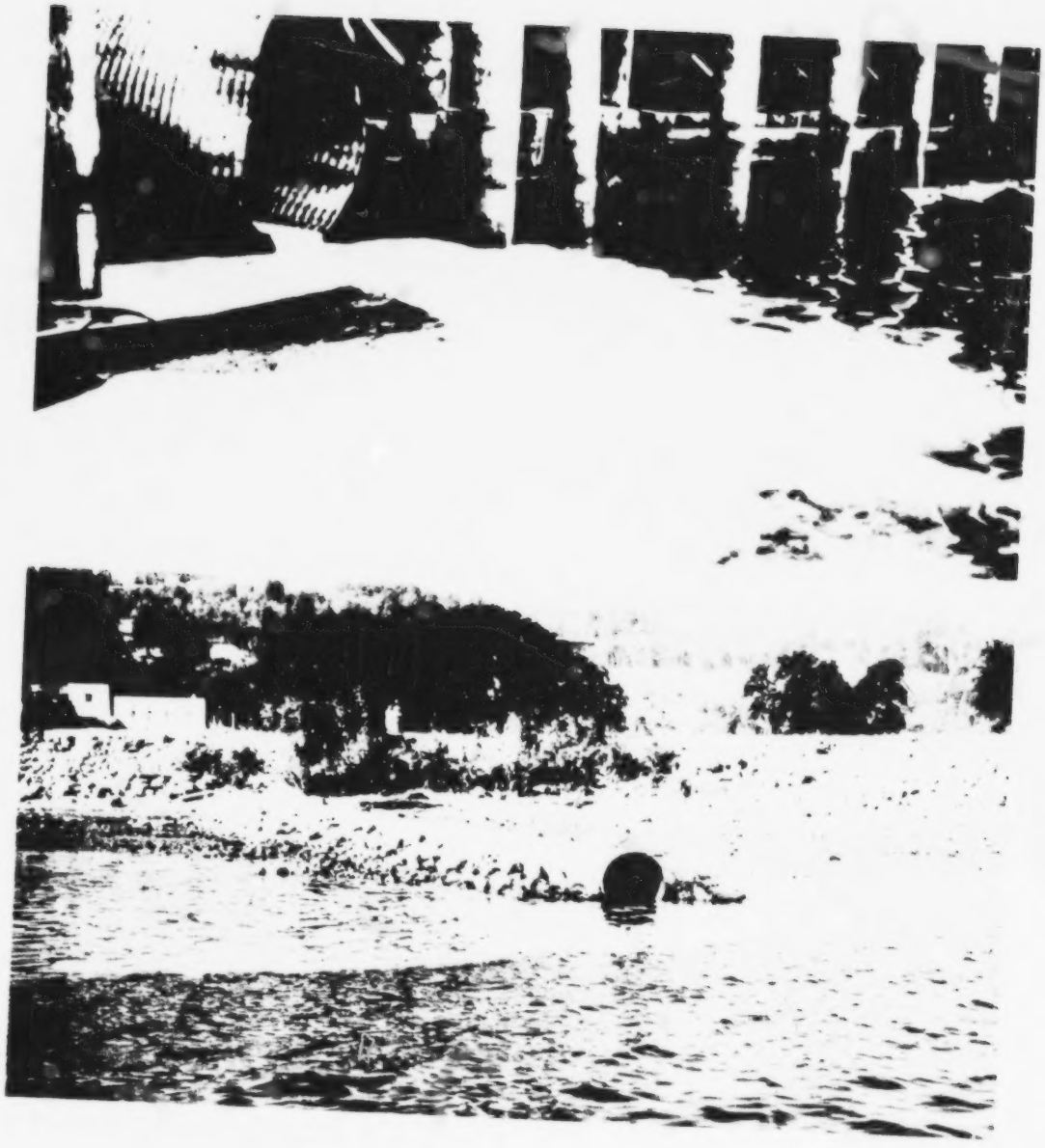
vent toxic materials from entering surface waters should be devised and used at the earliest date.

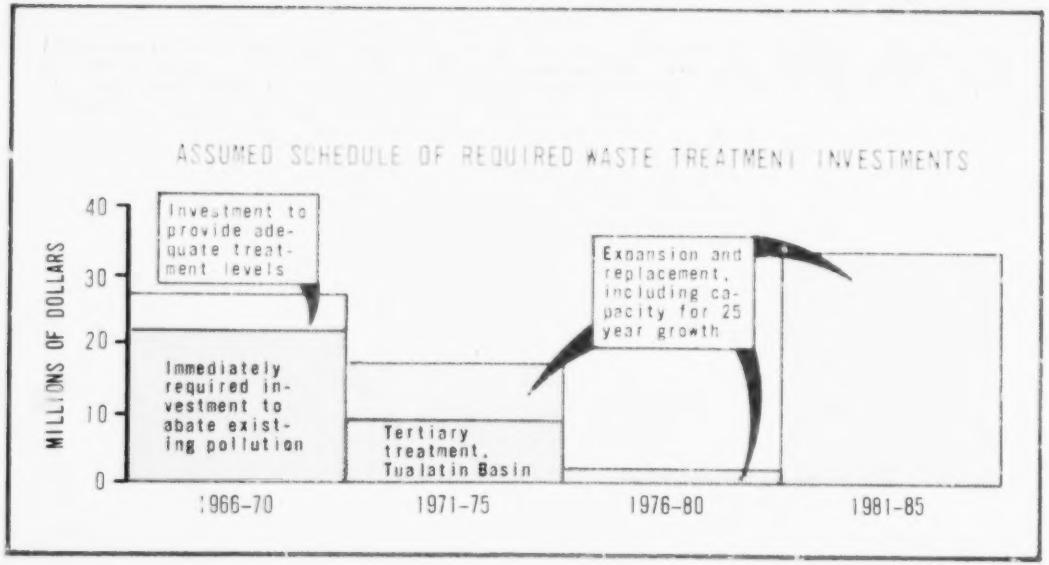
Research and development needs also exist. These can be approached through existing national programs of pollution control research, since the pollution problems of the basin are not unique to the area. In the Willamette Basin, research requirements center largely upon methods to control urban and forest land drainage and stormwater overflows.

In the area of social and institutional practices, it would be desirable to develop mechanisms for pollution-control institutions that are based upon the circumstances of watersheds. The Clean Waters Restoration Act of 1966 offers considerable Federal incentive opportunities for development of such institutions, recognizing the efficiencies to be derived in scheduling and cooperative financing of waste collection and treatment facilities and in orderly development and implementation of pollution control plans.

VI. COST OF POLLUTION ABATEMENT AND CONTROL

Costs of pollution abatement and sustained pollution control will not be small. Estimates of the cost of measures required to end existing pollution and to provide a level of waste treatment that meets the requirements of the Oregon State Sanitary Authority and the "adequate treatment" standard required for allocation of storage in Federal reservoirs indicate that about $30 million must be invested in waste collection and treatment facilities over the next five





years. Roughly a third of the amount—an estimated $14 million—will be required from pulp and paper mills, for installation of treatment for removal of settleable solids and reduction in strength of pulping liquors. Another $12 million is attributed to the completion of an interceptor sewer by the city of Portland, in order to end the discharge of a portion of its untreated wastes to the Willamette River. About $14 million must be spent to provide secondary waste treatment to municipal and industrial wastes from several sources, and to increase the standard of efficiency in the several municipal treatment systems that are overloaded or otherwise inadequate.

Waste treatment construction costs will persist after adequate treatment is available. Expansion of waste production and obsolescence of treatment facilities will, as time passes, result in continuing pressures on treatment capabilities. Calculations of investment requirements have been projected. These are based on the application of existing technology, 1965 price levels, depreciation schedules based on twenty-five year treatment plant life, and regional allocations of projected population and industrial output. The cost projections indicate that an additional $65 million will have to be spent—including $8.5 million for advanced waste treatment in the Tualatin River Basin and $19.0 million for additional treatment of pulp and paper wastes—to maintain an effective level of waste treatment through the year 1985. Because of the assumed twenty-five year operating life of such facilities, the major portion of waste treatment investments through the year 2010 is assumed to be designed into the cost projection.

In sum, then, the communities and industries of the Willamette River Basin can anticipate the need to expend about $105 million (1965 dollars) for waste treatment during the two decades between 1965 and 1985. About forty percent of this amount must be spent over the next five years if abatement of existing pollution is to be achieved at the earliest date. Because prevailing practice dictates that treatment plant and sewer capacity be designed to accommodate anticipated expansion of waste loads, the incidence of costs may be expected to decline markedly once adequate waste treatment capabilities have been installed, then to climb again in the 1980's as facilities that were built during the late 1950's and early 1960's have to be replaced.

While pulp and paper mills will have to bear almost a third of the total anticipated cost of waste treatment, the other two-thirds will be spread unevenly among the individual communities and industries of the basin. In many cases these costs may be expected to constitute a considerable burden. Anticipation of such costs should assist municipalities to meet them in an orderly fashion; and Federal grants for treatment plant construction will be a major aid in meeting waste treatment requirements of communities — and, indirectly, of those industries which utilize cooperative municipal-industrial treatment works. Watershed pollution control arrangements could serve a function in easing financial burdens of communities, both by providing expertise in scheduling construction requirements and by spreading the incidence of costs.

Other cost elements, too, must be incurred in meeting pollution-control requirements. Reservoir storage capacity having a value in excess of $20 million will be provided by the Federal government, if allocation of storage to provide recommended base streamflows is granted. It is estimated that roughly a million dollars will be required to completely adjudicate existing water rights in order to provide dependable base streamflows for legitimate water uses, including water quality control. Funds must also be invested in monitoring equipment to provide a knowledge of the day-to-day quality, and influences on quality, of the river system.

willamette river basin